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A TIME VARYING STUDY OF WATER VIEW PREMIUMS IN RELATION TO RESIDENTIAL HOUSE PRICES.

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Abstract

In contrast to the large body of research that exists on the impact of water view premiums of on the value of residential properties there are relatively few studies that look at how these premiums vary over time. A Water view premium has a significant impact on a residential property's value as indentified in previous studies and therefore understanding the way in which the water view premium behaves over time is of major importance and has significant implications for residential property valuation.

This study aims to better understand the behavioural patterns of the water view premiums over time and determine if there are any linkages between market cycles by comparing the movements of the water view premium to the market index and another leading study that looks at water view premiums over time.

This study analyses 3842 residential property sales from 4 similar Auckland suburbs for the period from 2005 to 2013. The sales are analysed using hedonic linear regression models with dummy variables for the presence of water views to isolate the water view coefficient for each of the years. The movements of the water view premium is then compared against a market index for the same period and the results also compared against another similar study from an earlier period.

The results indicate a strong behavioural pattern between the correlation of the market growth and water view premium growth. A pattern emerges that suggests that for a short time after a market has recovered from a period of major negative growth (a market crash), the water view premium has a period of dramatic positive growth that is greater than the growth of the market. This pattern is also evident when comparing the results to the earlier study.

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List of Abbreviations

Parcel_ID	- Land Parcel identification code
GIS	- Geographical Information System
LINZ	- Land Information New Zealand
GFC	- Global Financial Crisis

Statement of Original Authorship

The work contained in this dissertation has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: ___________________________

Date: ___________________________

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Chapter 1: Introduction

1.1 BACKGROUND

The following background gives a short explanation of how the author became interested it the subject of study and also a brief explanation of the status of the subject at the current time of writing.

From mid-2004 to mid-2005 the author worked as residential valuer in Auckland under the guidance of Munroe Graham, a valuer who had a strong interest in the theory of residential valuation. Whilst valuing over that year the author observed how properties with significant water views appeared to increase in value at a greater rate than other similar properties with lesser views. The author queried this phenomenon with Mr Graham whom explained that throughout his 40 years of experience his thoughts were that the water view coefficient was increasing at a greater rate than the average market appreciation for Auckland. Unfortunately Mr Graham had not put time into researching this noticeable phenomenon and could quantify or substantiate it. This observation and the words of Mr Graham spurred the authors interest in this area of study. The inclusion of a dissertation as part of the authors master's course seemed like an opportune time for the author to further his curiosity of quantifying view premiums and investigating the water view premium behaviour.

Earlier research on the subject of water view premiums by Benson, Hansen, Schwartz & Smersh (1998), Bourassa, Hoesli & Sun (2003a, 2003b) and Fillippova (2009) has highlighted the significant impact that a water view can have on a property's value. Theirs, and other studies (Fraser & Spencer, 1998 ; Palmquist, 1992), have identified how view premiums differ between localities and demographics. In a notable piece of research of Bourassa *et al.* (2003b), which furthered earlier research by them in the area of water view premiums completed in 2003 (Bourassa *et al.*, 2003a), they studied the time-varying nature of three attributes which included water view premiums, and identified links to property value indices. This study proposes to build on Bourassa's *et al.* (2003b) research by examining the gap of knowledge related to the time varying nature of water view premiums and draw conclusions about how water view premiums behave in relation to market movements.

1.2 CONTEXT

The context of this study follows the work previous completed on the time varying nature completed by Bourassa's *et al.* (2003b). However in contrast to Bourassa's *et al.*(2003b) study this research proposes to focus on the water view premium specifically, investigate the behaviour of the water view premium throughout a major crash and limit the study to four neighbouring suburbs with similar characteristics to assist with the problems of poor "delineation of homogenous submarkets" (Straszheim, 1974) as later discussed in Section 2.3 of the Literature Review.

Questions that the research intends to answer are:

- What is the average growth rate of water view premiums over the period and is it a likely representation of a long-term average?
- Do the water view premium growth rates relate to index growth rates?
- Do the results of this study align with Bourassa's *et al.*(2003b) study in a different time period?
- How do water view premiums behave during a major economic collapse?

Major foreseen difficulties with the study would be incorrect sampling definition, omission of important variables and reliance on the quality of CoreLogic's data without complete knowledge of how it was obtained.

1.3 PURPOSES

The purpose of this study is to further understand how water view premiums behave in relation to property values by examining water view coefficient movements over time when compared to market movements. This is important because it assists in understanding the behaviour of a major component of a property's value and therefore helps limit the potential for under or over valuation.

The water view coefficient is a multiplier that is derived through hedonic linear regression. It is a numerical measure of the impact a water view has on the value of a property.

The aims of this study are to:

- To better understand the nature/behaviour of views in relation to residential market movements.
- Expand on the understanding of how view premiums behave during a major collapse.

The objectives of the study are to:

- Determine whether the long term average growth rate of water view premiums is greater than that of the market growth.
- Determine if there is a linkage between the behaviour of view premiums in different property cycles over different time periods.

1.4 SIGNIFICANCE, SCOPE AND DEFINITIONS

Many earlier studies relating to water view premiums, such as the work of Benson *et al.* (1998), Fraser *et al.*(1998), Filippova (2009) etc., have focused on the magnitude to which varying views impact residential property values at a particular point in time. Studies of this nature, without the inclusion of time analysis, add only to the strong base of research confirming that presence of a water view has a significant impact on the value of a residential property. The conclusions from these studies can therefore only be applied to particular locations, at particular points in time, and tell us little about likely behaviour of the water view premium and which stage of a cycle it is in. A gap in the current knowledge of water view premiums therefore exists in the understanding of how water view premiums behave over time. This study in contrast proposes to further the work of Bourassa's *et al.* (2003b) by studying the time varying nature of the water view coefficient in an attempt to establish a pattern of behaviour. By comparing the movements of the water view coefficient from four similar suburbs within Auckland from 2005 to 2013 against the combined market movements of those suburbs of the same time period, this study attempts to derive a linkage between the two that will indicate the behaviour of the water view premium.

Also if a linkage is established between the subject study and the prior research of Bourassa's *et al.* (2003b) between the way water view coefficients behave during property cycles, this would mean that consideration of the stage of the property cycle would have to be taken into consideration when using hedonic models applied to residential house valuation.

The scope of this study is limited to identifying the movements of the water view coefficient for comparison. When the term "market" is applied it relates to the aggregate of the four Auckland suburbs in the study being; Orakei, Mission Bay, Kohimarama and St Heliers. It does not attempt to address other externalities that may impact value such as neighbourhood quality.

1.5 DISSERTATION OUTLINE

The remaining chapters are outlined as follows:

- Chapter 2 is the Literature Review which is comprised of 8 sections. It provides a brief history and introduction to hedonic modelling, a summary of the body of literature relating to water view premiums and then discusses specifically the subject research in reference to prior work on the subject.
- Chapter 3 describes the Research Design. It is comprised of 3 sections and 2 sub-sections. The first main section, Section 3.2, describes the raw data and how it is transformed and used in the hedonic models. The next section, Section 3.3, details how the final outputs are generated and how the outputs are further analysed. Finally Section 3.4 discusses any ethical considerations and potential limitations of the study.
- Chapter 4, entitled Results, discusses the results of the study and issues that arose in practical application of the research design.
- Chapter 5, entitled Analysis, further analyses the results and discusses the implications of the outcomes.
- Chapter 6 provides a summary of the analysis, conclusions are drawn about the outputs and further areas of study are recommended.

The dissertation then concludes with the 3 additional attachments being; Bibliography, Appendices and Glossary of Terms.

Chapter 2: Literature Review

2.1 OVERVIEW

This chapter begins with the historic background of hedonic modelling and its applications (Section 2.2). The second section (Section 2.3) identifies the potential issues with hedonic modelling applied to property and advises how the issue is addressed in the subject study. The third section (Section 2.4) discusses "the attributes of a submarket" and defines the characteristics that impact on a property's value. The fourth section (Section 2.5) introduces the concept of applying values to particular attributes affecting a property's value. The fifth section (Section 2.6) discusses how an attributes impact on a property's value can change over time. The sixth section (Section 2.7) draws on elements of the previous sections (Sections 2.2 through 2.6) and relates them to the subject of water view coefficients. The final section (Section 2.8) then summarises the earlier sections.

2.2 THE HEDONIC MODEL

The term “Hedonic” ties its origins to ancient Greek vocabulary and is defined by Oxford Dictionaries (Oxford Dictionaries, 2014) simply as:

“Relating to, characterized by, or considered in terms of pleasant (or unpleasant) sensations."

This definition can be interpreted to imply that the term hedonic has “characteristics” that are connected to some measure of “utility” therefore. The modelling of something hedonic is a process whereby utility values are attributed to these characteristics. The most common way to define the utility values of these characteristics is through a process called “Hedonic Regression”. Hedonic regression is effectively regression analysis and the original form of this was the least squares model which was detailed by Adrien-Marie Legendre in 1806 (*Encyclopaedia Britannica*, 2014) where the method was being used to estimate the paths of projectiles around the sun. Nowadays, a simple search of the internet and the resulting outputs, indicates that regression analysis is used for many more purposes, however it is commonly applied as a statistical tool in economics and in the valuation of residential property.

In 1978 Peter Linneman commented on the significance of hedonic functions in urban analysis for "understanding both locational and public policy issues as they provide consistent estimates of the marginal values of location-specific traits" (Linneman, 1978), Gardner, Brown & Pollakowski (1977) in 1977 used hedonic modelling in an attempt to answer the question "Have public agencies through zoning acted in a socially optimal way?", Palmquist in 1992 saw the usefulness of hedonic modelling and made the comment "Determining people’s willingness to pay for environmental improvements or to avoid environmental degradation is important in designing environmental policies. Similarly, policymakers must frequently consider the compensation that people would require to accept reductions in environmental quality" (Palmquist, 1992) and therefore used hedonic regression to determine the price that should be paid for reductions in environmental quality. Fraser *et al.* (1998) believed that the results of their hedonic study could be applied in "coastal land use management decisions", and in 2009 Filippova (2009) stated that the results of her study could be "directly applied to residential valuation practice and in particular mass appraisal systems".

As identified in these studies and others, hedonic modelling is powerful tool that can be used for many important uses including the creation of social policy, making informed environmental decisions, and assisting in the mass appraisal of real estate. The ability to breakdown mass data into components to provide consistent results is a major strength of hedonic regression and that is why it is applicable to this study. There are however also limitations using the approach as discussed in the next section.

2.3 DEFINING THE DATA

This section of the literature review discusses one of the major issues with applying hedonic regression to property and the learning's that are made and how these learning's are applied to subject study.

In 1974 Mahlon Straszheim (1974) in a paper entitled " Hedonic Estimation of Housing Market Prices: A Further Comment" stated that "the central problem in estimating hedonic equations involves the delineation of homogenous submarkets." He then went on to state that "A growing literature exists which has neglected this problem. These studies use a common methodology; housing prices are regressed on housing stock and neighborhood characteristics, using data drawn from throughout the metropolitan area. Unfortunately the assumptions required to justify pooling data throughout an urban area are not likely to be met". Straszheim then went further to qualify this comment by stating that ""The urban housing market" is a set of compartmentalized and unique submarkets with demand and supply influences likely to result in a different structure of prices in each. A huge variation exists both in the types of housing available across geographic sub-markets within a metropolitan area and in the demand for housing of a given type at a given location" (Straszheim, 1974). It is evident that in 1974 Straszheim was not content that proper conclusions were being drawn on the market as whole and believed that for accurate interpretation, sub-markets should be studied individually to account for the many varied aspects that made up each.

Later, Goodman (1977) in 1977 completed a study along the lines of Straszheim's (1974) definition of an "urban housing market" that separated the internal house components and external neighbourhood qualities into value components using regression analysis and concluded that "An overall model using the entire sample often provided incorrect values of 15%" (Goodman, 1977). Furthermore, Palmquist (1992) in a relatively specialised paper entitled "Valuing localised externalities" argued that hedonic modelling is best suited for "studying localized externalities" because "the hedonic methodology and benefit estimation do not arise". He went on to conclude that "because the externality is localized, it is only necessary to estimate the hedonic equation for a relatively homogeneous neighborhood. This makes the specification of the regression easier since most of the neighborhood and governmental characteristics, which are often the most difficult to quantify, do not vary within the sample". Palmquist (1992) therefore was implying that it was best to focus on similar submarkets for researching a particular externality to avoid the deficiencies in regression models as identified by Straszheim (1974) and Goodman (1977).

In 2003, Bourassa *et al.*(2003a) noted that "when analyzing the impact of views one should include measures of the visual quality of the immediate surroundings of the property in question as well as the overall appearance of the neighborhood in which the property is located" implying that the significance of the externalities could create submarkets and affect the interpretation of the results. Bourassa *et al.*(2003a) then stated "to limit the impact of these external variables this study proposes to take focus on the view variable by studying similar suburbs and limiting the variance of the external variables". Bourassa *et al.*(2003a) also noted that "several studies suffer, however, from a poor definition of view, from measurement error or from a small sample size". Suggesting that as well as poorly defined samples there is also a potential for the results to be incorrect due to the method of collection of the data.

Filippova (2009), in a study on how views impact property values in 2009 which built on Bourassa *et al.* (2003b) earlier work, also commented on the continuing theme of poor definition of submarkets and stated "the empirical results indicate that the regionwide [sic] model chronically over or underestimates view premiums, for example, the regionwide [sic] model estimates that a wide water view adds 18 per cent to a home's value while the same view amenity adds only 5 per cent in modest West Harbour but 54 per cent in posh Mission Bay". Filippova (2009) defined the submarkets in her study based on number of people within a meshblock, properties with the meshblock exhibiting views and consideration of socioeconomic data.

Therefore in line with the previous work of Palmquist (1992) and Bourassa *et al.*(2003a) this study attempts to limit the submarket defining issue by focusing on 4 similar suburbs of Auckland at a similar stage of development with similar socioeconomic occupants and similar water views.

2.4 ATTRIBUTES OF A SUBMARKET

As discussed above, there are features of certain submarkets that are likely to taint the results of any study if the submarkets are not adequately defined and the sample size is too large or too small. Identifying the features that impact the greatest is of paramount importance when defining the submarket. This Section of the paper refers to prior studies and important attributes of note when defining a sample.

Gardner *et al.*(1977) defined these features in a statement; "A given housing unit is best characterized as consisting of a bundle of attributes which describe the structure itself, the land upon which it is built, and the relevant locational characteristics". Historically studies have struggled to identify these attributes, such as Goodman (1977).

Linneman (1978) in his paper "Some Empirical Results on the Nature of the Hedonic Price Function for the Urban Housing Market" raised the important issue of understanding the application of hedonic models and importance of including the correct variables. He commented that "We further found empirically that neighborhood-specific traits are important determinants of a site's valuation, explaining 15 to 50% of the standardized variation in valuations and inducing differential valuations as large as 100% between structurally identical sites", he then went on to state that the cost of policy errors based on these studies would be large. Linneman (1978) highlighted the importance of identifying the traits that make up a property's value and then noted in his conclusion that it is also important to understand the behaviour of these traits in his comment "Since there is little reason to believe that the results found for 1973 will generalize to other years (i.e., relative prices vary over time) the main contribution of this paper is to help in establishing a consistent and systematic statistical procedure to be used by urban economists in the study of urban housing markets and in evaluating relevant public and private policy decisions". Importantly Linneman recognises that one year results cannot describe the behaviour of an attribute and can therefore only " help in establishing a consistent and systematic statistical procedure" (Linneman,1978).

Bourassa *et al.* (2003a) made the following opening comments when describing the list of attributes that make up a property's value; "The value of a residential property depends on its physical and locational characteristics. The number of rooms, age of the property, condition of the building, and size of the lot are important physical characteristics that are usually easily measurable. Variables pertaining to the location of a property should comprise neighborhood quality variables, but also variables measuring the relative location of properties within a city". It can be taken from this comment that Bourassa *et al.*(2003a) was making a clear statement that a property's value is made up of a mixture of various attributes that are particular to the property itself and other external location characteristics. similar to Gardner *et al.*(1977).

Bourassa *et al.* (2003a) completed one of the more comprehensive studies of 5000 sales in Auckland encompassing a broad spectrum of attributes and concluded that "A house located in a neighborhood with a superior appearance of landscaping will command a premium of 5% relative to a house in a neighborhood with average landscaping, while the value of a dwelling in a very poorly landscaped neighborhood can be depreciated by as much as 51%. The appearance of landscaping in the neighborhood on property values thus appears to have much more of a downside potential than an upward potential, at least in Auckland where the standard seems to be relatively high. The reverse conclusion prevails for the appearance of structures in the neighborhood. A house located in a neighborhood with superior structures will have a premium of up to 37%, while the potential negative impact is only 14%. As can be seen, the effects of the appearance of the neighborhoods and immediately surrounding improvements are important, and as such they represent a significant part of aesthetic externalities". Therefore, as highlighted in Bourassa *et al.* (2003a) study, considering that a potential premium of up to 37% can be attributed for locational superior structures, locational characteristics are extremely important factors to consider in any hedonic model relating to property values and should be considered when defining a sample of properties.

2.5 DEFINING THE VALUE OF AN ATTRIBUTE

The previous sections of this Chapter have reviewed the body of literature relating to the hedonic model as applied to property, the consideration of property attributes in regression modelling and issues relating to applications of hedonic regression as applied to property. This section discusses what defines the demand or importance of an attribute and introduces the concept of elasticity.

So what determines the value of each of the attributes? Gardner *et al.* (1977) stated that "At any given time, there exists a given distribution over space of the supplies of these attributes. We make this assumption since the housing stock is altered only slowly over time, and because some attributes, such as certain neighborhood amenities, are supplied perfectly inelastically. On the demand side, assuming a given spatial distribution of employment and a given distribution of preferences and income over households, we may envision a distribution over space of demands for these attributes. The housing market is thus viewed as consisting of implicit markets for each of the attributes of housing, broadly defined, and it is assumed that at any given point in time a vector of implicit short-run equilibrium prices exists". In this comment Gardner *et al.* (1977) is implying that the market for any attribute is defined by supply of that attribute and the demand for it at a particular point in time. The fact that a reference is made to a "short-run equilibrium" is an important point and is dealt with later in the literature review (Section 2.5).

In 1980 according to Pollard (1980) land was allocated to the use that produced the greatest return and he noted "According to traditional theory, competitive bidding among potential users will asure [sic] that land is allocated to the activity commanding the highest rent". Similar to Gardner *et al.* (1977), Pollard (1980) refers to an economic answer for the value that is attributed to a property's attributes. Bourassa *et al.*(2003b) continues with the theme and notes "The results for Auckland provide strong evidence for the fact that the implicit price in real terms that is being paid for aesthetic externalities that are in limited supply is sensitive to demand changes" and then continues later with "We find that real prices of the aesthetic attributes vary with changes in demand. This is because of the limited supply for such attributes, in the short and medium term anyway. In contrast, supply of floor size is more elastic, and the elasticity of that attribute is found to be quite constant over time. Percentage price impacts for water views are found to be inversely related to availability of such views, a result that is consistent with theory". Once again, similar to Gardner *et al.*(1977), Bourassa *et al.*(2003b) notes that the value of each attribute is likely to change over time and the idea of attributes being elastic or inelastic is reintroduced.

Elasticity is an economic term to describe the demand behaviour of an attribute as the price changes. An attribute is considered "elastic" if a small change in price results in a greater change in the quantity demanded. Inversely, an attribute is considered "inelastic" if a change in price results in a lesser change in demand for quantity of the attribute. Theory suggests that attributes that are less likely to vary i.e. neighbourhood amenities, are likely to be inelastic, whereas, features of the house, items that are upgradable or replaceable, will be more elastic as tastes, costs of production, availability of labour etc. changes. Observing the behaviour of an attribute using hedonics can determine whether or not that attribute is considered elastic or inelastic. Benson *et al.*(1998) commented "In a market with increasing demand, characteristics with a relatively inelastic supply - view amenities, for example - are more likely to rise in price than characteristics with a relatively elastic supply". Comments such as this suggest a "grey area" in the body of research relating to water views and indicates that further study is required to understand the behaviour of the view coefficient and its elasticity.

2.6 THE CHANGING VALUE OF AN ATTRIBUTE

This section of the literature review discusses the importance of investigating the movements of an attribute over time and references previous studies that have identified this issue.

A major flaw in many studies arises when conclusions are drawn without acknowledging whether a coefficient maybe elastic or inelastic. Many studies have not investigated how a coefficient behaves over time and instead assumptions are derived off a study completed using data from a particular point in time. A number of notable studies however have addressed the factor of time; Straszheim (1974) eludes to the fact that characteristics are changing over time and comments "A wide variation in the density and other characteristics of the housing stock can be observed in a given location at any point in time, principally reflecting the fact that the stock was built over a long period of time when factor and output prices varied", later Goodman (1977), in a study investigating why people were moving from the city to the suburbs, concluded that hedonic modelling was best applied to smaller submarkets, and not for deriving a long-term average.

Linneman (1978) (as early noted in Section 2.2) suggested that his study was based on data for 1973 only and that other studies could use his study as a base for further investigation. Bourassa *et al.*(2003a) in a more recent study and being one of the more notable studies on view coefficients concluded that "For this analysis, we use data for one year, 1996. Clearly, the results from a limited case study of this sort cannot be generalized to other times and places. The relatively fixed supply of views of water and land suggests that the percentage impact of such externalities will vary depending on where a housing market is in the property cycle", Bourassa *et al.*(2003a) then goes on to note that further study is required to investigate the time-varying nature of view coefficients and later that year a paper is published by Bourassa *et al.*(2003b) called "The Price of Aesthetic Externalities" which forms the basis of this subject study. In it Bourassa *et al.* (2003b) focuses on the "time varying" nature of three attributes; "whether or not a property has a water view; the appearance of nearby improvements; and the quality of landscaping in the neighborhood", (Bourassa *et al.*,2003b). This paper is one of the few that have provided meaningful research into the behaviour of the water view coefficient over time.

2.7 THE WATER VIEW COEFFICIENT

The justification for this study, techniques used to complete the research and the body of literature discussing the techniques, has been discussed in the prior sections of this chapter. The next section of this chapter deals directly with the water view coefficient and prior research that has been completed on the subject.

Positive price effects, or view premiums, from the presence of water views has grown as subject in recent decades; In the late 90's Benson, Hansen, Schwartz, Jr & Smersh (1998) noted that little research had "focused on the impact of views, and ocean views in particular, on the value of single-family residential properties" (Benson *et al.*, 1998). Benson *et al.* (1998) conducted hedonic research to estimate "the value of the view amenity in single-family residential real estate including ocean, lake, and mountain". Bensons *et al.* (1998) research indicated that views could add 8% for the lowest quality sea view and up to 60% for the highest quality views suggesting that views had a significant impact on the value of a residential property.

In 1998 Rob Fraser and Geoff Spencer (Fraser & Spencer, 1998) proposed a hedonic valuation model which involved scoring views based on their measure in degrees and by the potential for the view to be lost by construction. The potential for view loss introduced an effective time function in their scoring that suggested the view constant could vary over time. They ran two models which presented similar results.

Bourassa *et al.* (2003a) expanded on previous hedonic research of views and included coefficients for type of view, scope of view, distance to coast in addition to quality of surrounding improvements. In line with the previous research of Benson *et al.* (1998) Bourassa *et al.* (2003a) suggested that a wide water view would add on average a 59% to the value of a waterfront property. Bourassa's *et al.* (2003a) research concluded that in conducting further research "the first direction would be to examine the time-varying nature of the premiums on aesthetic externalities and to relate these price impacts to the real estate cycle" (Bourassa *et al.,* 2003a). Bourassa's *et al.* (2003a) conclusion highlighted a gap in the study of how aesthetic externalities premiums varying over time in relation to market movements.

As discussed earlier in Section 2.6 in 2003 Bourassa *et al.* (2003b) went further to bridge this gap by investigating the time-varying nature of three attributes relating to the value of a residential property being; presence of water view, appearance of surrounding improvement and quality of landscaping in the neighbourhood. They compared the coefficient movements of these three attributes against the official New Zealand Government indices for Auckland, Wellington and Christchurch for residential sale transactions from the period of 1986 to 1996. Values in Christchurch rose steadily over this period whereas Auckland and Wellington followed more of a cyclic nature. Bourassa's *et al.* (2003b) concluded that "the real estate indices of water views and good landscaping in Auckland track the index of real house prices", in Wellington it was identified that water view premiums made a strong departure from real house prices, almost doubling over the time frame and in Christchurch the there was also a substantial rise. The fact that Auckland water view premiums rose at the same rate as the real house price index as oppose to Wellington and Christchurch, which experienced an above index trend, was not explained and would suggest further research is required in this area. Also in review of Bourassa's *et al.* (2003b) results it appears that from the period 1992 to 1996 (the beginning of a new cycle) that the results followed more closely with the result of Wellington Christchurch i.e. the premium increased at a greater rate than the index, this again suggests that more research is required in this area since this trend was not explained either. There is potential that the large amount of data they were dealing with, which was the greater Auckland area, provided a smoothing effect. Also they stated that there was a bubble in the Auckland residential market at the time of their research which may have impacted the results.

Olga Fillippova (2009) then conducted research progressive to Bourassa's *et al.* (2003b) work on views however investigating the correlation between submarket view premium and socio-economic status. Fillippova (2009) noted a distinction between similar wide view scopes between suburbs in that a lower socio economic suburb was only experiencing a premium of 18% whereby a more posh area was experiencing a 54% premium for a similar view scope. Fillippova concluded that the research could be extended by exploring why such variations exist. There is potential this variance could be partially explained by how the view premium varies over time in relation to the market i.e. if there is a correlation between the view premium and the market movements for individual suburbs and the view premium increases at a greater rate than the market.

Therefore from a review of prior research it is clear that there is a gap in the knowledge of how view premiums behave over time and a justification for further research on this subject.

2.8 SUMMARY

In summary, this study proposes to expand on Bourassa's *et al.* (2003b) prior work by exploring the gap of knowledge relating to how water view premiums behave over time in relation to market movements using hedonic regression. In line with findings of Palmquist's (1992) work, suggesting that it is best to investigate localised externalities, the subject study has been based on data from four, well developed, older suburbs in Auckland, a similar distance to the CBD with similar water views. These suburbs have been selected to limit the effects of poorly defined submarkets. The subject suburbs neighbour each other and are all considered part of the "East coast bays" of Auckland. In an attempt to establish the behaviour of the water view coefficient, and not merely provide a picture of a "short-run equilibrium" (Gardner *et al.*,1977), the data analysed is over a nine year period from 2005 to 2014, over which time a major global economic crisis is experienced. The water view coefficient is examined over this period and compared to Bourassa's *et al.* (2003b) earlier work in an attempt to establish similarities. The intention is to establish a pattern that may describe the behaviour of the water view coefficient. An established pattern could then be used in further research or applied in practice when using mass residential appraisal models.

Chapter 3: Research Design

3.1 The purpose of this chapter is to discuss the methodology, research design, analysis techniques, ethical considerations used to address the purposes of the study as earlier described in Section 1.3 of the paper. The chapter is structured as follows; Section 3.1 of this chapter discusses the methodology and research design for the study, it details how the data is transformed into the usable variables, what software is used for the analysis and how the outputs will be generated. Section 3.3 discusses how the results will be analysed and interpreted. Section 3.4 deals with any potential ethical issues rising from the study and any potential limitations.

3.2 METHODOLOGY AND RESEARCH DESIGN

3.2.1 METHODOLOGY

Applying findings from earlier studies such as Palmquist (1992) and Bourassa's *et al.* (2003a) the methodology of this study is designed to study the behaviour of the water view coefficient over time.

The primary dataset of sales has been provided by CoreLogic. CoreLogic are the largest complier of property data in New Zealand. The raw dataset is made up of sales from January 2005 to June 2014 in the Auckland suburbs of Orakei, Mission Bay, Kohimarama and St Heliers. A diagram of these suburbs and the location of them within Auckland can be found in the Appendices as 6.1.1 "Appendix A: Map of Suburbs " and 6.1.2 "Appendix B: Location of Suburbs Within Auckland Region" respectively. In total the raw data is comprised of 4468 sales provided in a Mircosoft Excel spreadsheet format. In line with the findings of Palmquist's (1992) work these suburbs were chosen to limit the effects of non-localised externalities impacting on the results. All of the subject suburbs therefore have a similar proximity to water, similar views, are at a similar stages of development and have similar demographics

The fields provided from the CoreLogic dataset that are to be included in the model are as follows:

Field Name	Description
Sale_Date_Year	Year of sale
Sale_Date_Quarter	The quarter that the sale occurred in
Sale_Price_Net	The net sale price
Land_Area	Total land area
Area_Unit	Suburb identifier
Category_Sale	Property type, age and condition
LUD_Land_Use_Description	Description of the use on the land
LUD_Bldg_Floor_Area	Main house floor area
MAS_View	Whether the property has a view and what the view is of
MAS_View_Scope	The scope of the view; slight, moderate, wide
MAS_Deck_Indicator	Deck identifier
Improvement_Description (curr)	Description of the improvements
Legal_Description	Legal description
LUD_Age	Main house age
Bldg_Cond (curr)	Main house condition
PARCEL_ID	LINZ property identifier
X	GIS Coordinate
Y	GIS Coordinate

Table 1 - Proposed CoreLogic Variables to be Included in the Study.

Initially the data is filtered and outliers removed while in Excel spreadsheet format. Outliers are removed in keeping with Bourassa's *et al.* (2003b) and Fillippovas (2009) prior work, floor areas less than 30m2 are removed as are floor areas greater than 360m2 (241 sales were removed in this category). Acceptable lot sizes range between 150m2 (182 sales were removed in this category) and 3,000m2 (5 sales were removed in this category). Outliers are also removed (they were listed as; fire damaged (2 sales were removed in this category), childcare centers (2 sales were removed in this category), and sales over 8 million dollars (3 sales were removed in this category).

Sale_Date_Year and Sale_Date_Quarter will be combined to generate a sale quarter and year as one variable. Next columns will be added displaying each of the quarters as a dummy variables coded as either a 1 or 0. The Sale_Price_Net will be normalised by using its natural logarithm in the model. Land_Area is useable in the form provided. Area_Unit is transformed into columns and dummy coded using 1's and 0's. LUD_Land_Use_Description is used as a filter for separating out the residential sales in Excel but does not form part of the final regression model. LUD_Bldg_Floor_Area and its square (BFA_SQ) are to be used in regression model to account for the diminishing cost of houses with larger floor areas. MAS_View is split into the category columns; no view, view and water view" and dummy coded as 1's and 0's to identify which one of the view states apply to the property. MAS_Deck_Indicator is provided as simply 'Y' and 'N' in the raw data which is transformed into 1's and 0's respectively for use in the model. Improvement_Description (curr) is used as a filter in Excel to eliminate properties with pools and tennis courts.

In contrast to the work of Bourassa *et al.* (2003b) multi-unit data is included in the model. This data represents a significant portion of the sales data and exclusion may introduce the potential for the model to suffer from lack of a sufficient amount of data. The land area of these sales is derived by taking the total land area and dividing it by the legal share as shown in the legal description. Therefore Legal_Description is broken down using Excel formulas to extract the total land area of each multi-unit site which is then divided by the share attributed to that unit as shown in the Legal_Description to a arrive at a land area for each particular sale. These areas are then combined with the other areas for freehold standalone house sales.

LUD_Age is transformed into separate columns identifying the vintage of the house using dummy coding of 1's and 0's. Bldg_Cond (curr) is transferred into two columns showing "good" exterior condition and "poor" or "fair" (combined) exterior condition in the other. Dummy variables are used to define each. Using the “Right” formula in Excel, the interior condition is derived by extracting the last letter off the Category_Sale column which is then dummy coded (if "A" or "C") for good and fair. PARCEL_ID and the X and Y coordinates were provided in a separate spreadsheet and are to be loaded into ESRI’s ArcMap to derive the distance to the coast for each property using the GIS coordinates provided by CoreLogic. This data is then combined with the main spreadsheet using Excel formulas and the PARCEL_ID as the key identifier.

The data is then loaded into a "Statistics Data Document" that can be used for analysis with IBM's statistical analysis software, SPSS. The instructions for the regression are written using SPSS syntax in the syntax module of SPSS. The variable selection significance is 0.05 (or only results at the 5% significant level are accepted).

3.2.2 RESEARCH DESIGN

Once the data has been filtered and the data prepared as described in the previous section, the following independent variables are used in the regression:

Field Name	Description
LUD_Bldg_Floor_Area	Main house floor area
BFA_SQ	Main house floor area squared
Land_Area	Total land area
Beds_2orless	Dummy variable for 2 bedrooms or less
Beds_4	Dummy variable for 4 bedrooms
Beds_5ormore	Dummy variable for 5 or more bedrooms
Ext_Good	Dummy variable for good external condition
Ext_Poor	Dummy variable for poor external condition
Interior_Good	Dummy variable for a good interior
Interior_Poor	Dummy variable for a poor interior
Other_View	Dummy variable for a view other than water
Water_Wide	Dummy variable for a wide water view
Water_Moderate	Dummy variable for a moderate water view
Water_Slight	Dummy variable for a slight water view
Vint_2010	Dummy variable for house built in the 2010's
Vint_1910	Dummy variable for house built in the 1910's
Vint_1920	Dummy variable for house built in the 1920's
Vint_1930	Dummy variable for house built in the 1930's
Vint_1940	Dummy variable for house built in the 1940's
Vint_1950	Dummy variable for house built in the 1950's
Vint_1960	Dummy variable for house built in the 1960's
Vint_1970	Dummy variable for house built in the 1970's
Vint_1980	Dummy variable for house built in the 1980's
Vint_1990	Dummy variable for house built in the 1990's
Pool	Dummy variable for the presence of a pool
Tennis_Court	Dummy variable for the presence of a tennis court
NON_FS	Dummy variable for non-freehold property
Deck	Dummy variable for the presence of a deck
au516500	Dummy variable for suburb location
au516601	Dummy variable for suburb location
au516602	Dummy variable for suburb location
au516700	Dummy variable for suburb location

Table 2 - Proposed Variables to be Used in the Study.

An initial regression will be run on the total sample using all sales with dummy variables for quarters with quarter one 2005 as the base date and the natural logarithm of the sale price as the dependant variable. The default is a 3 bedroom freehold site with a house built in the 2000's with no view with average quality interior and exterior.

The residuals of this model are saved and the regression preformed again using sales that fall within residuals of positive three and negative three as a conservative measure. This will generate a market index for the suburbs over the period of the data. Next consecutive models will be run for each of the quarters and the coefficients for water view extracted for each of the quarters. Likewise the residuals are saved and the regression preformed on the sales within the positive three/negative three threshold. The data from the regressions is then put into an excel spreadsheet and analysed as per the "Analysis" section following.

3.3 ANALYSIS

This section discusses how the outputs of the market and annual regression models will analysed.

To derive the market index the model an SPSS regression model is run for all quarters using quarter one 2005 as the default (The results of this regression are shown in Table 6.1.3 Appendix C: Market Regression). The coefficients relating to each of the years is then transformed into a percentage movement from the base year by deriving the inverse of the natural logarithm using the following formula:

$$100 * [e^{(\beta)} - 1]$$

Where β is the coefficient for each year (Fillippova, 2009). The Mircosoft Excel formula used is shown below:

=100*(EXP(cell reference)-1)

The quarterly percentage movements are calculated from the output data by taking the following quarter's value, deducting the previous quarter's value from it and dividing by the previous quarter to get derive the movement from the previous quarter. The results are then plotted to show a graphical representation of the data (these results follow later in Chapter 5 Figure 1 - Market House Price Index).

The coefficients from the water view for each quarter are then dealt with in a similar way whereby the inverse of the natural logarithm is derived using the Excel formula above. The outputs are then indexed by observing the variance in the transformed coefficients and applying the growth rates derived to a base figure (these results follow later in Chapter 5 Figure 2 - Annual Change in Market Index vs Water

View Premium). The results of these outputs will be discussed in terms of their descriptive statistics. The market chart will be discussed in terms of its relevancy and whether it accurately depicts what was experienced throughout the time frame. This data is then compared graphically to the water view premium movements chart and discussed. The two sets of listed results will be compared using Pearson's correlation coefficient. Interpretation of the results will then be discussed and conclusions derived. Lastly the long-term rate of appreciation will be discussed and its validity considered.

3.4 ETHICS AND LIMITATIONS

The writer assumes no ethical considerations with the study. The analysis and results are limited only by the quality of the data provided by CoreLogic and the inclusion of satisfactory descriptive variables to describe the dependent variable. The study is only explanatory of the 4 suburbs chosen and further study is recommended in the conclusions in Chapter 6.

Chapter 4: Results

This chapter begins with a review of the data input into the regression models, an overview of issues experienced in the application of the research design, followed by a discussion of how these issues were addressed and the final inputs into both the market and annual models. The output observations of the model are then discussed and basic statistical descriptive data considered. The chapter concludes with a discussion on notable observations and whether or not these results were expected.

After initial filtering of the results as per the criteria; floor areas less than 30m2 and floor areas greater than 360m2 being excluded, acceptable lot sizes ranging between 150m2 and 3,000m2 and removal of a small number of anomalies, a final yield of 4032 observations remained for use in the model. The GIS coordinates supplied by CoreLogic were provided in a separate spreadsheet and were linked to the main data using parcel_ID as the key.

Unfortunately upon running the model it became clear that there were errors with the coordinates or Parcel_ID's that had been provided, and the model was providing irrational results. Therefore it was decided at this point that the inclusion of the "distance to coast" variable should be abandon. It is believed that this would not heavily impact the results of the study as the study is investigating the behaviour of the water view coefficient entirely and not each "distance to coast" component of the water view variable.

Also, upon separating the data into sets of quarterly sales, the results were suffering from a low number of sales for each quarter. Therefore the decision was made to complete the regression using annual datasets rather than quarterly.

The variables used in the initial market index regression model therefore were as follows:

Field Name	Description
LUD_Bldg_Floor_Area	Main house floor area
BFA_SQ	Main house floor area squared
Land_Area	Total land area
Beds_2orless	Dummy variable for 2 bedrooms or less
Beds_4	Dummy variable for 4 bedrooms
Beds_5ormore	Dummy variable for 5 or more bedrooms
Ext_Good	Dummy variable for good external condition
Ext_Poor	Dummy variable for poor external condition
Interior_Good	Dummy variable for a good interior
Interior_Poor	Dummy variable for a poor interior
Other_View	Dummy variable for a view other than water
Water_Wide	Dummy variable for a wide water view
Water_Moderate	Dummy variable for a moderate water view
Water_Slight	Dummy variable for a slight water view
Vint_2000	Dummy variable for house built in the 2000's
Vint_2010	Dummy variable for house built in the 2010's
Vint_1910	Dummy variable for house built in the 1910's
Vint_1920	Dummy variable for house built in the 1920's
Vint_1930	Dummy variable for house built in the 1930's
Vint_1940	Dummy variable for house built in the 1940's
Vint_1950	Dummy variable for house built in the 1950's
Vint_1960	Dummy variable for house built in the 1960's
Vint_1970	Dummy variable for house built in the 1970's
Vint_1980	Dummy variable for house built in the 1980's
Vint_1990	Dummy variable for house built in the 1990's
Pool	Dummy variable for the presence of a pool
Tennis_Court	Dummy variable for the presence of a tennis court
NON_FS	Dummy variable for non-freehold property
Deck	Dummy variable for the presence of a deck
au516500	Dummy variable for suburb location
au516601	Dummy variable for suburb location
au516602	Dummy variable for suburb location
au516700	Dummy variable for suburb location
Sale_2006	Dummy variable for a sale that occurred in 2006
Sale_2007	Dummy variable for a sale that occurred in 2007
Sale_2008	Dummy variable for a sale that occurred in 2008
Sale_2009	Dummy variable for a sale that occurred in 2009
Sale_2010	Dummy variable for a sale that occurred in 2010
Sale_2011	Dummy variable for a sale that occurred in 2011
Sale_2012	Dummy variable for a sale that occurred in 2012
Sale_2013	Dummy variable for a sale that occurred in 2013
Sale_2014	Dummy variable for a sale that occurred in 2014

Table 3 - Variables Used in the Market Regression Model.

The market regression was then run again for observations with residuals between positive three and negative three, please refer to Section 6.1.3 "Appendix C: Market Regression", for the table displaying these results. A total of 3993 observations were used in the regression with only a loss of 39 observations from the initial regression, or 1%. Pearson's R is high at 0.837 which indicates a strong linear relationship between variables and the dependant variable. R Squared is also high and has a value of 0.701 which indicates that the independent variables have a high power of explanation of the dependant variable. Adjusted R Squared has little variation from the R squared value at 0.698 indicating that the amount of variables are sufficient in explaining the dependant variable.

The Standard Error of the estimate is low at 0.224 which also indicates a good linear fix. The P value is below 0.000 therefore all results are significant at the 5% level. All view coefficients are positive and increase as the scope increases which to be expected and consistent with previous studies.

When running the regression for the view coefficients it was found that separating the view scope out into each scope category yielded few sales within each category and there was reason to believe that CoreLogic's categorisation of views lacked consistency. This raises the question as to how the data was collected and uniformity of measurement. Therefore to examine the water view coefficient the variables Water_Wide, Water_Moderate and Water_Slight were combined into a single variable named Water_view.

Therefore for each annual dataset the following variables were used in the regression:

Field Name	Description
LUD_Bldg_Floor_Area	Main house floor area
BFA_SQ	Main house floor area squared
Land_Area	Total land area
Beds_2orless	Dummy variable for 2 bedrooms or less
Beds_4	Dummy variable for 4 bedrooms
Beds_5ormore	Dummy variable for 5 or more bedrooms
Ext_Good	Dummy variable for good external condition
Ext_Poor	Dummy variable for poor external condition
Interior_Good	Dummy variable for a good interior
Interior_Poor	Dummy variable for a poor interior
Other_View	Dummy variable for a view other than water
Water_View	Dummy variable for a view of water
Vint_2010	Dummy variable for house built in the 2010's
Vint_1910	Dummy variable for house built in the 1910's
Vint_1920	Dummy variable for house built in the 1920's
Vint_1930	Dummy variable for house built in the 1930's
Vint_1940	Dummy variable for house built in the 1940's
Vint_1950	Dummy variable for house built in the 1950's
Vint_1960	Dummy variable for house built in the 1960's
Vint_1970	Dummy variable for house built in the 1970's
Vint_1980	Dummy variable for house built in the 1980's
Vint_1990	Dummy variable for house built in the 1990's
Pool	Dummy variable for the presence of a pool
NON_FS	Dummy variable for non-freehold property
Deck	Dummy variable for the presence of a deck
au516500	Dummy variable for suburb location
au516601	Dummy variable for suburb location
au516602	Dummy variable for suburb location
au516700	Dummy variable for suburb location

Table 4 - Variables Used in Annual Regression Models.

For each annual regression the residuals were saved and the model rerun using the same variables for residuals between three and negative three. The table below shows the number of observations used and lost between rerunning the regression:

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total Observations in Initial Regression	486	538	459	306	431	394	389	467	426	137
Total Observations After Removal of Observations with Residuals Greater than +3 and Lower than -3	473	531	456	303	426	390	383	461	419	137
Observations Lost Between Models	13	7	3	3	5	4	6	6	7	0
Lost Observations as a Percentage of Original Sample	3%	1%	1%	1%	1%	1%	2%	1%	2%	0%
Observations Per Independent Variable	16	18	16	10	15	13	13	16	14	5

Table 5 - Observations Data

Total sales in the Auckland region for the period December 2013 to November 2014 totalled 28,299 ("Market Facts", 2014). This would suggest that each of the annual samples used reflects around 1.5% of the total sales for the greater Auckland region.

As shown in the table above there was a low loss of observations between regression models. "Observations per in dependant variable" are equal to or above the rule of thumb being, ten observations per independent variable (Harrell, 2001), in all years excluding 2014. Results from the 2014 regression are therefore excluded from the annual regressions analysis. Please refer to Section 6.1.4 "Appendix D: Annual Regression Coefficients" for a table displaying these results. Number of observations ranged from good (300) to very good (500+) as determined by Comrey and Lee (1992) (as cited in Zhao, 2014).

Throughout the years 2005 to 2013 Pearson's R values were high ranging from 0.798 to 0.868 and Standard Error of the Estimate ranged between 0.197 and 0.274. The regression models also had good explanatory power with R squared values ranging between 0.636 and 0.753. Adjusted R Squared ranged between 0.609 and 0.733 for the years and support the explanatory power of the independent variables. The P value is below 0.000 therefore all results are regressions were significant at the 5% level.

Important variables significantly affecting the value of property indicated by high coefficients include; the area of land, the condition interior of the house, the age of the house particularly if the house was built between 1910 and 1920, the presence of water views and whether the property had a pool or not.

As expected, on average having a house built in the 2010's commanded a premium over houses built in the 2000's. However interestingly houses built between 1910 and 1930 also commanded a premium. This is likely due to the villa influence throughout the period.

Houses with more bedrooms experienced a slight premium over the 3 bedroom default, however 5 bedrooms showed a negative coefficient indicating that they are less desirable which may be due to larger houses requiring more maintenance costs. A non-freehold/multi-unit site showed on average a 7% discount compared to freehold properties.

Chapter 5: Analysis

This chapter begins with a review of the descriptive statistics of the outputs and a quality assessment of outputs provided. A graphically representation of the market index is then presented and discussed. The water view premium movements over the same time period are then presented and discussed. Interpretations of the results are then made and conclusions developed. The results are then compared against the results of Bourassa's *et al.*(2003b) study and discussed. Finally the possibility of long-term rates of appreciation for the market and water view premiums explored and discussed.

The results of the regression models showed initial indication that they were providing robust outputs with; high R Squared and Adjusted R Squared values, low Standard Error of the Estimate values and P values all equalling 0.000. These results provide a base for the following analysis. The remainder of this section is set out as follows; firstly the results of the market index are presented and discussed, next the water view coefficient results are presented and compared against the market results, the results are then viewed from a perspective of growth, patterns identified and finally the results are compared against Bourassa *et al.*(2003b) results and the objectives and aims considered.

Below is a chart displaying the house price index derived from the initial regression model using 2005 as the base year:

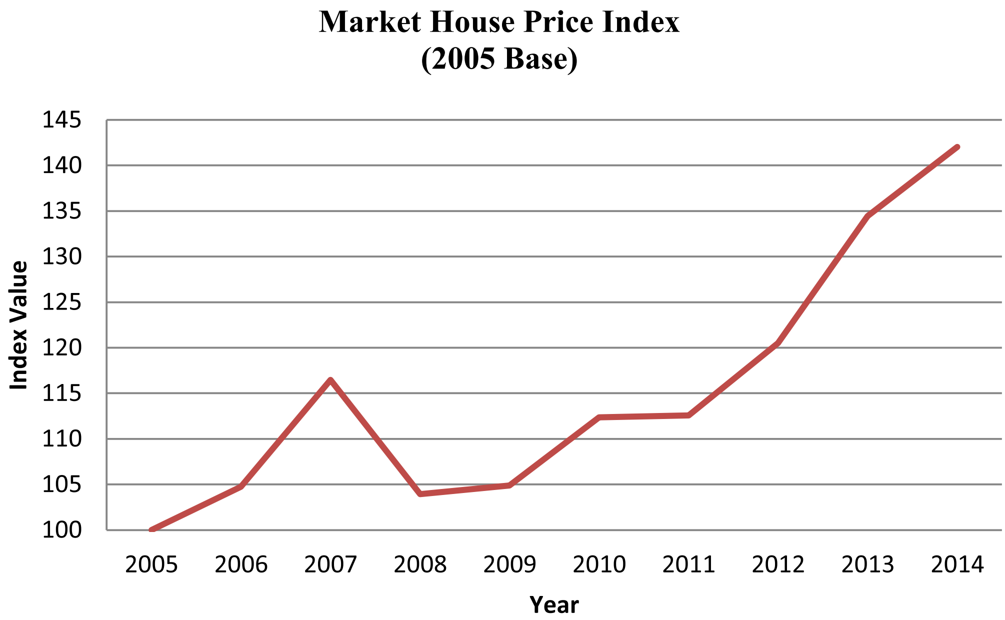

Figure 1 - Market House Price Index

As shown above the market experienced good growth throughout 2005 increasing 2006 up until 2007 when the Global Financial Crisis (GFC) occurred. Shortly afterward there was rapid decline through 2008 followed by slight/near stagnant growth throughout 2009 then moderate growth up until 2011 at which stage growth accelerated again right through to 2014.

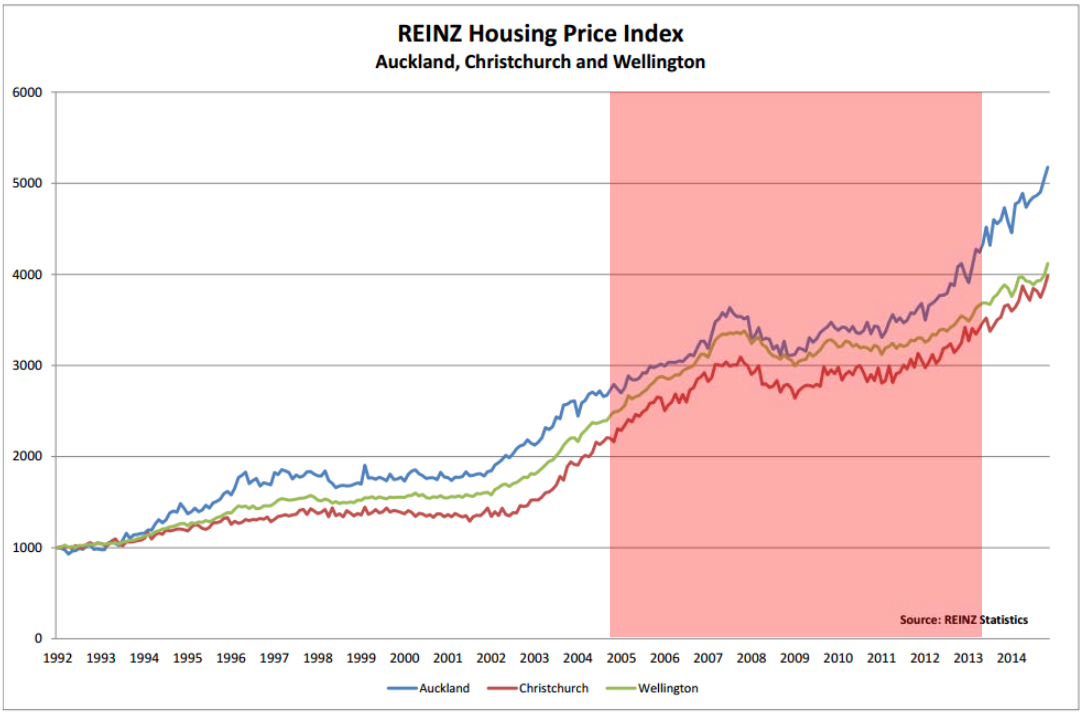

Figure 2 - REINZ Housing Price Index

Above is a chart showing the REINZ Housing Price Index (REINZ Housing Price Index, 2014) for New Zealand's major cities with the period of study highlighted in red. The blue line shows the trend of Auckland houses prices which accurately reflects the trend of the four suburbs as shown in Figure 1 - Market House Price Index as derived from the model.

The chart below shows the growth rate of the water view coefficient plotted against the market. As discussed earlier in the results section of the paper on page 33, the 2014 results yielded only five observations per variable and therefore have been excluded from the analysis.

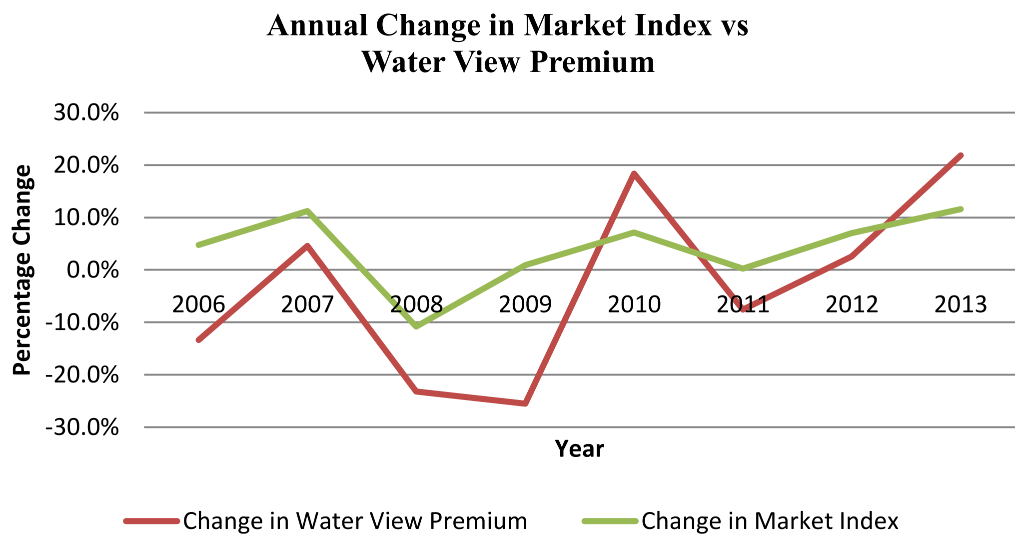

Figure 3 - Annual Change in Market Index vs Water View Premium

As indicated in the chart above there is a strong correlation between the market index and water view premium. The correlation coefficient of the two datasets is high with a positive value of 0.8176. Referring to the chart the areas of non-correlation appear to occur after a market downturn.

Focusing on the decline in market growth throughout 2007 the water view premium tracks the market's decline downwards although at a greater rate, it then continues to decline throughout the following year while the market recovers prior to bouncing back at a much greater rate than the market index in the following year 2009. Likewise where there is a decline in market growth throughout 2010, the water view premium follows the decline and then in the following year recovers slightly, albeit at not such a high rate as the market. Then in 2013 it bounces back again over taking the market growth.

The decline in the water view premium throughout 2008 therefore would suggest that the market was extremely overheated, and post the GFC the demand for luxury properties was still in decline as there were fewer purchasers that could afford these properties. A similar pattern emerges in 2012, one year after the decline whereby the growth of the water view premium over takes the growth in the market.

In reference to the objectives of the study, as previously discussed the water view premium has a strong positive correlation, the movements of market index and a strong relationship is evident between the two. This was also a pattern indentified in Bourassa's *et al.*(2003b) study. In relation to the question of how water view premiums behave after a major economic collapse, it is identified that the premium that a purchaser will pay for a water view has a major decline, greater than that of the market. This is likely due to the lack of surplus money available to generate demand for this attribute. Shortly after a decline however when the market begins to recover, water views become "in vogue" again and increase at a greater rate than the market as more people have surplus cash available to demand these types of properties.

In direct comparison with Bourassa's *et al.*(2003b) study's (results relating to the Auckland market) there are linkages in the behaviour of the water view premium. Other than the fact both models indicate that water view premium is closely linked to the market index, after a major crash (the years through 1990 to 1994 in Bourassa's *et al.* (2003b) study) both studies show that the water view premium overcorrects for roughly a year beyond the bottom of the market index and then dramatically increases at rate beyond the market in the few years following. The scope of this study cannot determine if the magnitude of water view premium recovery or the duration after a major crash are typical of all locations with water views, however the author recommends this as an area for further study. In review of the results published by Bourassa's *et al.* (2003b) relating to Christchurch and Wellington, there are indications for this to be true however without further analysis these assumptions cannot be conclusive.

Below is the chart from above displaying a linear trend line of two datasets:

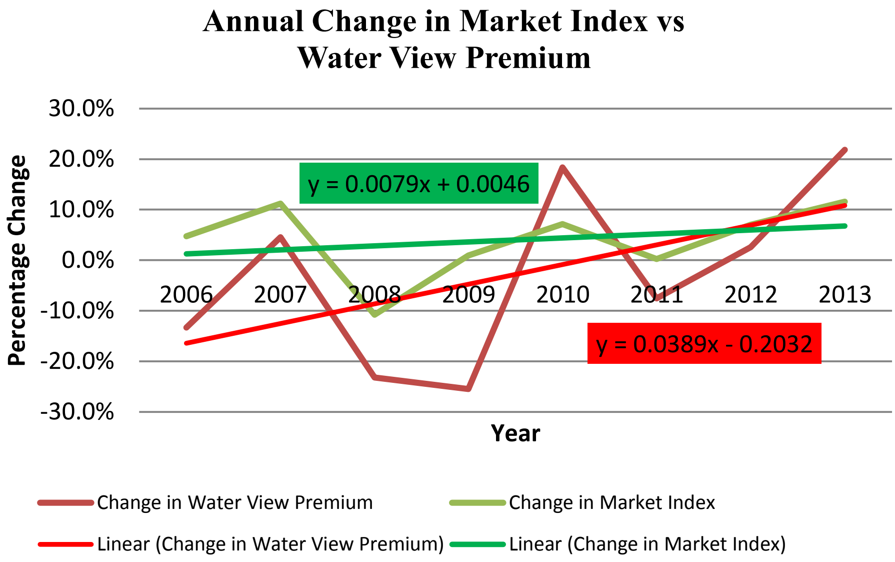

Figure 4 – Long Term Growth Comparison of the Market Index vs Water View Premium

Over the nine year time period of the study it is indicated that water premium increases at a roughly 4% per annum whereas the long term market growth rate is only circa 0.8%. The above analysis is a very basic estimate only and cannot be relied upon as any long term average is highly dependent upon the starting and finishing period used. In comparison to the work Bourassa's *et al.*(2003b) both studies throughout their time periods indicated that the water view premium grows on average at a greater rate than market.

Viewing the above results from a valuation perspective, the deviation of the water view premium from the market index creates a period whereby a valuer could potentially undervalue a property with significant water views as it is likely that it will increase above the market growth rate in the following year. The author believes this effect is likely to be experienced more dramatically in areas more dominated by holiday homes and this would be a recommended area for an area of further study also. The period of recovery of the water view premium after a major decline in the market for different locations (i.e. holiday home locations vs larger cities where a home is more of a necessity) therefore would also be a further area of study recommended.

Chapter 6: Conclusions

In conclusion, the study has identified a strong behaviour pattern between the correlation of the market growth and water view premium growth. This was also evident in work previously completed by Bourassa *et al.*(2003b). Similarly a pattern has emerged that suggests that in a short time after a market has recovered from a period of major negative growth (a market crash), the water view premium has a period of dramatic positive growth that is greater than the growth of the market. The author notes however that this is a pattern that has been identified in these two studies only and recommends further analysis to determine whether this could be accepted as a general statement.

The results of this study suggest that this effect should be considered by valuers after a period of steep decline as ignoring this effect may heavily undervalue a property with significant water views basing its value on previous sales from a declining or stagnant market. Further study is recommended by the author to examine the period of when the upswing in water view premium growth is likely to occur post a market downturn, and also the likely magnitude of the increase. The writer recommends looking at different locations that may be more dominated by holidays homes that may experience more significant movements in value prior to and post a market crash.

Thirdly the results of this study and Bourassa *et al.*(2003b) suggest that long-term the water view premium grows at a greater rate than that of the market. The writer notes however that this is an observation only and recommends that further study is necessary to confirm this statement.

Finally the writer would like to discuss the issue of data quality and data availability. This is a common issue identified in many studies such as; Pollard (1980), Benson *et al.*(1998), Fraser *et al.*(1998), Bond *et al.*(2002), Bourassa *et al.*(2003a) and Bourassa *et al.*(2003b). There are ongoing patterns within these papers related to the availability of data, the quality of data and the ability to rely on this data. The writer experienced issues in the subject study relating to the GIS data provided and the uniformity in the measurement of view scopes which unfortunately limited the scope of the study and left some unanswered questions. However with the rapid pace of technology such as, 3D Google earth and capabilities of modern algorithms, the writer is hopeful that in the future even attributes such as the measurement of view scope may be automated in the future.

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Appendices

6.1.1 APPENDIX A: MAP OF SUBURBS

Figure 5 - Map of Suburbs

6.1.2 APPENDIX B: LOCATION OF SUBURBS WITHIN AUCKLAND

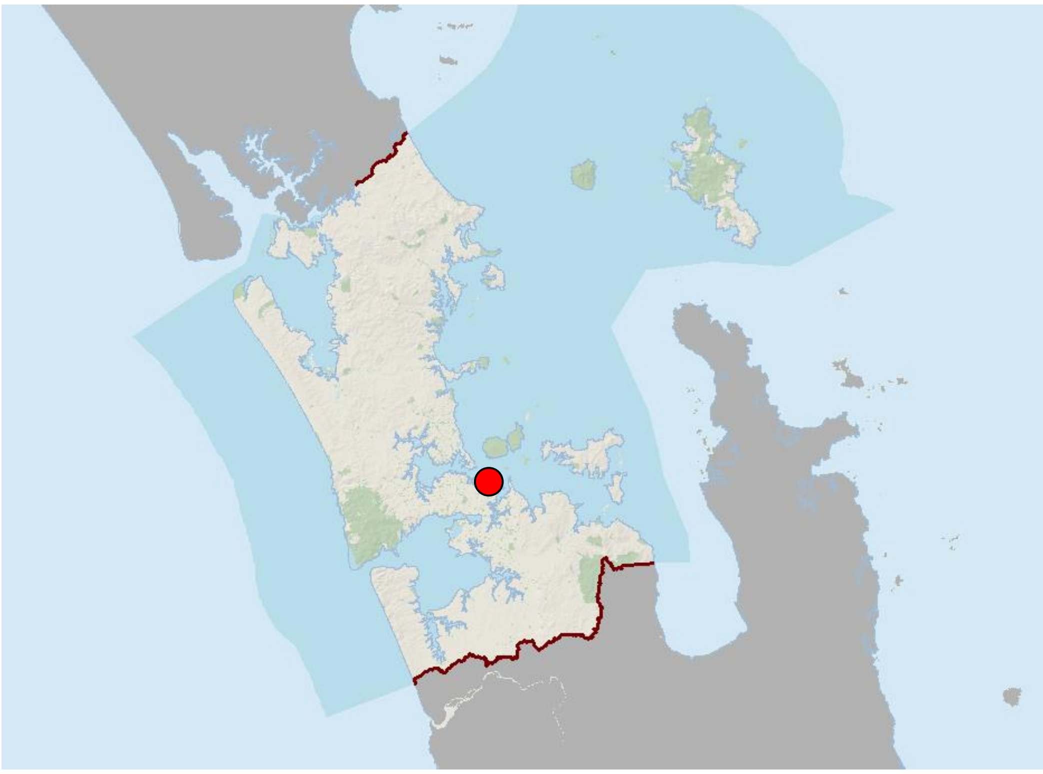

Figure 6 - Location of Suburbs within Auckland Region

6.1.3 APPENDIX C: MARKET REGRESSION

Variables	Unstandardised Coefficients		Standardised Coefficients		
	B	Std. Error	Beta	t	Sig.
Constant	12.853	.040		319.992	0.000
LUD_Bldg_Floor_Area	.003	.000	.407	7.341	.000
BFA_SQ	-2.413E-07	.000	-.016	-.304	.761
Land_Area	3.763	.169	.262	22.222	.000
Beds_2orless	-.032	.015	-.022	-2.132	.033
Beds_4	-.003	.009	-.004	-.340	.734
Beds_5ormore	-.034	.015	-.023	-2.241	.025
Ext_Good	.042	.009	.048	4.676	.000
Ext_Poor	-.032	.028	-.010	-1.130	.258
Interior_Good	.195	.014	.135	13.490	.000
Interior_Poor	.055	.038	.013	1.444	.149
Other_View	-.003	.010	-.002	-.260	.795
Water_Wide	.473	.019	.232	24.753	.000
Water_Moderate	.215	.027	.072	7.978	.000
Water_Slight	.114	.009	.123	12.229	.000
Vint_2010	.059	.029	.019	1.998	.046
Vint_1910	.060	.077	.007	.783	.434
Vint_1920	.018	.028	.006	.648	.517
Vint_1930	-.003	.017	-.002	-.173	.862
Vint_1940	-.015	.017	-.011	-.850	.395
Vint_1950	-.099	.016	-.079	-6.038	.000
Vint_1960	-.221	.019	-.132	-11.787	.000
Vint_1970	-.186	.020	-.094	-9.111	.000
Vint_1980	-.113	.016	-.097	-7.303	.000
Vint_1990	-.147	.013	-.150	-10.947	.000
Pool	.103	.013	.077	8.092	.000
Tennis_Court	.072	.077	.008	.928	.353
NON_FS	-.078	.009	-.095	-8.331	.000
Deck	-.014	.008	-.016	-1.753	.080
au516500	.044	.011	.044	3.877	.000
au516601	.048	.013	.043	3.825	.000
au516602	.036	.012	.034	2.893	.004
au516700	.056	.011	.056	4.913	.000
Sale_2006	**.046**	.014	.039	3.210	.001
Sale_2007	**.153**	.015	.119	10.193	.000
Sale_2008	**.038**	.017	.025	2.312	.021
Sale_2009	**.048**	.015	.036	3.151	.002
Sale_2010	**.116**	.015	.085	7.527	.000
Sale_2011	**.119**	.016	.086	7.609	.000
Sale_2012	**.186**	.015	.147	12.513	.000
Sale_2013	**.296**	.015	.223	19.391	.000
Sale_2014	**.351**	.022	.157	16.026	.000

Table 6 - Market Regression

6.1.4 APPENDIX D: ANNUAL REGRESSION COEFFICIENTS

Variables	Unstandardised Coefficients									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	B	B	B	B	B	B	B	B	B	B
(Constant)	13.078	12.976	13.085	13.239	12.948	12.824	12.686	12.937	12.864	13.669
LUD_Bldg_Floor_Area	.001	.002	.001	-.001	.001	.003	.005	.004	.005	-.002
BFA_SQ	4.993E-06	2.096E-06	3.460E-06	7.254E-06	2.039E-06	-1.117E-08	-3.943E-06	-3.042E-06	-7.531E-06	9.129E-06
Land_Area	3.614	3.877	5.108	3.412	3.349	3.297	3.743	3.762	3.981	2.584
Beds_2orless	-.056	-.065	-.156	.011	-.070	.031	-.026	-.033	.070	-.035
Beds_4	-.041	-.005	-.039	.035	.052	.011	-.010	-.036	.018	.061
Beds_5ormore	-.099	-.015	-.077	-.003	.060	-.114	-.133	-.066	-.012	.040
Ext_Good	.033	.039	.017	.065	.103	.011	.067	.030	.027	.050
Ext_Poor	-.135	.012	.054	.083	.079	-.058	-.263	-.124	-.058	-.006
Interior_Good	.197	.293	.161	.189	.219	.189	.243	.231	.270	.201
Interior_Poor	-.018	.467	-.013	-.123	N/S	N/S	.050	.205	.109	N/S
Other_View	-.026	.017	-.030	.019	-.056	.001	-.050	-.006	.026	-.013
Water_View	**.199**	**.177**	**.183**	**.147**	**.113**	**.132**	**.123**	**.126**	**.149**	**.074**
Vint_2010	N/S	N/S	N/S	N/S	N/S	.128	.110	.099	.023	.078
Vint_1910	.304	.135	.389	N/S	N/S	N/S	.020	N/S	N/S	N/S
Vint_1920	-.022	.003	-.094	.003	.064	.098	.094	.056	.145	.240
Vint_1930	-.118	-.052	-.020	-.077	.016	.106	.090	.052	.114	.150
Vint_1940	-.163	-.043	-.094	-.062	.027	.002	.081	.078	.106	.045
Vint_1950	-.174	-.131	-.194	-.142	-.043	-.090	.030	-.010	.019	.004
Vint_1960	-.305	-.215	-.396	-.305	-.076	-.161	-.082	-.258	-.086	-.169
Vint_1970	-.411	-.177	-.261	-.366	-.107	-.154	-.178	-.147	-.083	-.071
Vint_1980	-.186	-.114	-.097	-.129	-.059	-.054	-.099	-.059	-.034	-.140
Vint_1990	-.154	-.122	-.148	-.087	-.078	-.174	-.146	-.151	-.134	-.133
Pool	.138	.153	.096	.132	.198	.010	.108	.082	.066	.155
NON_FS	-.112	-.091	-.100	-.089	-.044	-.037	-.042	-.091	-.124	.017
Deck	-.026	-.033	-.028	.013	.016	.009	-.022	-.064	-.015	-.061
au516500	.010	.069	.020	.016	.032	.049	.065	.031	.028	-.001
au516601	-.049	.038	.042	.036	.065	.143	.074	.069	-.001	-.058
au516602	.021	.000	.015	-.014	.036	.097	.047	.026	.037	.017
au516700	.101	.106	.075	.084	.063	.106	.075	.013	.044	.029

N/S = No sales in this category in the particular year.

Table 7 - Annual Regression Coefficients

Glossary of Terms

Market Index - Residential property index derived from the aggregate sale price movements of the Auckland suburbs of Orakei, Mission Bay, Kohimarama and St Heliers for the period 2005 to 2013.

Movement - A positive or negative variation in a growth rate.

Regression Analysis - Linear regression analysis using the least squares form of regression.

View - The presence of a view from a residential property of something other than water.

Water View - A view of water encompassing wide, moderate and slight scopes of view.

Water View Coefficient - A numerical multiplier that represents the impact of a water view on a residential properties value.

Water View Premium - The premium that a purchaser would pay for a residential property with a water view.